

Surveys of Known and Potential Occurrences of William's Combleaf (*Polyctenium williamsiae* Rollins) and an Update on Distribution and Management

By

Alison E Stanton and Bruce M Pavlik

BMP Ecosciences

156 South Park San Francisco, CA 94107. (415) 5431115

Submitted to the

U.S. Fish and Wildlife Nevada Fish and Wildlife Office

1340 Financial Boulevard, Suite 234

Reno, NV 89502 (775) 861-6300

And

Nevada Division of Forestry

2525 South Carson Street,

Carson City, Nevada 89701 (775) 684-2500

And

Bureau of Land Management Carson City Field Office

5665 Morgan Mill Road

Carson City, Nevada 89701 (775) 885-6000

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PROJECT BACKGROUND

In 1997 Robert Holland developed a report on the most current knowledge and conservation status of William's combleaf (*Polyctenium williamsiae*) (Holland 1997). At that time there was taxonomic confusion between: *P. williamsiae* (POWI) and *P. fremontii* var. *confertum* (POFRc). The majority of individuals Holland had found possessed morphological traits that were intermediate with respect to type descriptions. In 2002, Noel Holmgren, of the New York Botanic Garden, reviewed the large series of *Polyctenium williamsiae*/*P. fremontii* var. *confertum* collections made by Holland and Jim Morefield of the Nevada Natural Heritage Program (NNHP) and concluded independently that *P. fremontii* var. *confertum* should be lumped into *P. williamsiae* and kept separate from *P. fremontii* (POFR). The NNHP and NDF adopted this taxonomy and nomenclature and *P. williamsiae* (including *P. f. confertum*) is currently listed as critically endangered by the state of Nevada, as a "special status species" of the Bureau of Land Management, and as a Forest Service "sensitive species".

Despite the taxonomic confusion, the 1997 report indicated a need to develop a comprehensive management plan for the recovery and conservation of POWI. In 2002, BMP Ecosciences submitted a proposal to the USFWS Nevada State Office to update the current knowledge and develop a POWI management strategy. The project was funded with Section 6 funds and administered as grant NV-E-5-TP-1 and NV-E-5-TP-2 by the Nevada Division of Forestry (NDF). BMP initiated field surveys in 2003 and 2004 and has provided POWI Site Survey and Summary Reports to NDF and USFWS in both years.

PROJECT OBJECTIVES

The 2002 project proposal contained four objectives: 1) prioritize occupied sites as no action, or low, medium, or high priority using existing data in the Nevada Natural Heritage Program and the California Natural Diversity Database, 2) develop a set of management prescriptions for each category, 3) design a long-term monitoring program to determine the effects of the different management regimes on *P. williamsiae*, 4) conduct field surveys to refine and update our conservation strategy.

Subsequent to the proposal development, a POWI working group convened in December 2002 to discuss development of a management strategy. At that time, Jim Morefield had just completed a supplement to the 1997 Holland report containing a comprehensive list of 178 potential POWI locations in CA and NV. As a result of the supplement and the taxonomic clarification, a key management objective was adopted for the 2002 project; develop a better understanding of the global distribution of POWI. To augment the limited Section 6 grant, BMP Ecosciences sought and obtained funds from the Bureau of Land Management Carson City office to conduct helicopter surveys of potential habitat and populations at remote sites in 2003 and 2004.

During project implementation it became apparent that the existing information was insufficient to adequately evaluate the geographic, ecological, and disturbance characteristics of POWI habitat and populations. The species was first described in 1983, so the archived data set is small and enigmatic. The known distribution is also complex, with extensive gaps between occurrence clusters along the California-Nevada border. Large variations in the sizes of surveyed populations

at surveyed sites further undermine predictive relationships with annual precipitation, elevation, and community type. Therefore, the 2002 project devoted much more time at known occurrences for collecting data on habitat factors, microdistribution and current threats. The expanded database will serve as a pre-cursor to future development of a comprehensive management plan and long-term monitoring program.

To satisfy the requirement of grants NV-E-5-TP-1 and 2, this project addresses three objectives: 1) update the current knowledge of POWI conservation status with results from field surveys of known occurrences conducted in 2003-2005, 2) categorize sites by degree of impact and accessibility and rank sites according to conservation and management priority, and 3) update the known distribution of POWI with results from helicopter surveys of potential occurrences conducted in 2003-2004.

FIELD SURVEYS OF KNOWN OCCURRENCES

Holland compiled all historical data and generated new data on *P. williamsiae* during his 1995 field surveys for the status report (1997). He found a combined total of 4,600 plants distributed among 16 ephemeral lake beds (playas) on public lands in Nevada. In addition, he tallied more than 420,000 plants at Larkin Lake, Mono County, California. His 1997 status report lists 25 POWI occurrences documented by field surveys or herbarium specimens. During 1999-2002, two new populations were discovered on playas in the Pine Nut Range of the Carson City BLM district. This list of 27 known sites of occurrence formed the basis for planning the 2003 -2005 field surveys. The NNHP has assigned an Element Occurrence (EO) record number to each site in Nevada and the CNDDDB has assigned EO record numbers to California sites.

Data Collection

Two separate data forms were developed for recording habitat and demographic information on each POWI occurrence. "Occurrence Record" forms were modeled after the NNHP and the California Natural Diversity Database (CNDDDB) Native Species Surveys Forms. Recorded population attributes included the total number, phenology, and highest density of counted or estimated individuals and the % cover and mean height of co-occurring species in the community. A cover class was assigned to any non-native weeds and the lakebed was mapped with a hand drawing and documented with a GPS location on a handheld Garmin unit (WGS 84 datum). "Site Record" forms were designed to capture contextual information about a POWI occurrence, including data on watershed attributes (lakebed dimensions), current management (presence of fencing, signage, or other restrictions) and disturbances and threats (grazing, OHV use, recreational use, and altered hydrology). Photos were taken at most sites. All completed datasheets are available from the USFWS or NDF and photos are available on CD (POWI 2003 to 2005 survey photos).

2003 Surveys

Data collection occurred on June 15-17, 26, and July 1-3, 2003. A total of 17 known sites of occurrence were visited (Table 1). POWI was not present at three. The lakebed at EO 23 at

Sagehen Springs was channelized next to the road and EO 24 at McBride Flat has filled in with shrubs so that neither site supported ephemeral lakebeds. Where plants did occur, population size ranged from less than 10 to approximately 2,500 individuals. Precipitation in 2003 was well below normal throughout the range of POWI. According to data from the Desert Research Institute (DRI) Western Regional Climate Center (WRCC), Virginia City and Carson City, NV, with only 4 and 6 inches, respectively, were well below their mean annual of 13 and 10 inches. Likewise, the 9 inches of precipitation at Bodie, CA was less than the mean annual of 13 inches. Despite the dry conditions in 2003, reproduction was robust. More than 90% of the observed individuals were in fruit during the survey period at nearly every site.

Table 1. Known occurrences of POWI visited in 2003 (EO = Element Occurrence). The number of plants is actual or estimated.

Land Owner	Site Name	County	EO	# plants
BLM	Virginia Range	Washoe	1	10 ³
BLM	Virginia Range	Washoe	2	10 ²
BLM	Virginia Range	Washoe	5	10 ¹
BLM	Virginia Range	Washoe	6	10 ¹
USFS-Inyo	Sagehen Springs WSW	Mineral	15	130
USFS-Inyo	Sagehen Springs W	Mineral	16	2,542
USFS-Inyo	Sagehen Springs NW	Mineral	17	75
USFS-Inyo	Sagehen Springs N	Mineral	18	8
USFS-Inyo	Sagehen Springs E	Mineral	23	0
USFS-Inyo	McBride Flat	Mineral	24	0
USFS-Toiyabe	Sweetwater SE	Lyon	21	5
BLM	Larkin Lake	Mono	CA901	911
Private	Mt Hicks	Mineral	10	131
USFS-Toiyabe	Anchorite Hills	Mineral	11	0
USFS-Toiyabe	Anchorite Hills	Mineral	12	250-500
BLM	Bodie Hills	Mono	CA903	3
BLM	Bodie Hills	Mono	CA904	300

2004 Surveys

Data collection in 2004 was conducted on four days in July (9, 15, 24, 28). A total of 10 known occurrences were visited and a combined total of 7,098 plants were tallied (Table 2). BLM Carson City crews obtained detailed plant counts for the Virginia Range sites and the new occurrences in the Pine Nut Range. They submitted all survey data on Occurrence and Site Record Forms to BMP Ecosciences. USFS crews from the Humboldt-Toiyabe completed forms for the Nye Canyon and Sweetwater sites in Lyon County and BMP Ecosciences visited occurrence #19. Precipitation in 2004 was greater than 2003, but still below normal. Carson City, Virginia City, and Bodie received 7, 9, and 8 inches, respectively (DRI, WRCC). Nearly 100% of the observed individuals were in fruit during the survey period at all sites, with the exception of occurrence # 19. The lakebed at Bald Mountain East was very dry and only about 30% of the counted individuals were in fruit. Other co-occurring species on that lakebed such as *Iva axillaris*, *Muhlenbergia richardsonis* and *Camissonia tanacetifolia* were also very sparsely distributed and appeared stressed.

Table 2. Known occurrences of POWI visited in 2004 (EO = Element Occurrence). The number of plants is actual or estimated.

Land Owner	Site Name	County	EO	# plants
BLM	Virginia Range	Washoe	1	1088
BLM	Virginia Range	Washoe	2	1061
BLM	Virginia Range	Washoe	5	1041
BLM	Virginia Range	Washoe	6	2,920
BLM	Pine Nuts (large lake)	Como	22	250
BLM	Pine Nuts (private lake)	Como	27	465
USFS-Toiyabe	Sweetwater SE	Lyon	21	0
USFS-Toiyabe	Bald Mountain, East	Lyon	19	250
USFS-Toiyabe	Nye Canyon South	Lyon	9	11
USFS-Toiyabe	Nye Canyon North	Lyon	8	7
Total				7,098

2005 Surveys

BMP Ecosciences obtained additional funding from BLM in 2005 to re-visit known occurrences and gather additional data for site categorization. BMP visited a total of 15 known occurrences in July and August (Table 3). The total count of 1,360 plants was sharply lower than the more than 7,000 counted among only 10 lakebeds in 2004. Precipitation was higher than normal in 2005. Carson City, Virginia City, and Bodie received 15, 14, and 12 inches, respectively (DRI, WRCC). Many of the playas filled with water, inundating previously occupied portions of lakebeds and reducing available habitat.

Table 3. Known occurrences of POWI visited in 2005 (EO = Element Occurrence). The number of plants is actual or estimated.

Land Owner	Site Name	County	EO	# plants
BLM	Virginia Range	Washoe	1	190
BLM	Virginia Range	Washoe	2	280
BLM	Virginia Range	Washoe	6	481
USFS-Inyo	Sagehen Springs WSW	Mineral	15	3
USFS-Inyo	Sagehen Springs W	Mineral	16	seedlings
USFS-Inyo	Sagehen Springs NW	Mineral	17	35
USFS-Inyo	Sagehen Springs N	Mineral	18	0
USFS-Inyo	Sagehen Springs E	Mineral	23	0
USFS-Inyo	Mc Bride Flat	Mineral	24	0
USFS-Toiyabe	Anchorite Hills	Mineral	11	0
USFS-Toiyabe	Anchorite Hills	Mineral	12	40
USFS-Toiyabe	Anchorite Hills	Mineral	28	3
USFS-Toiyabe	Bald Mountain, East	Lyon	19	0
USFS-Toiyabe	Sweetwater SE	Lyon	21	0
BLM	Pine Nuts (large lake)	Como	22	328
Total				1,360

EOs 19 and 21, located in the Sweetwater Range of Nevada, were visited on July 27, 2005. EO 21 had supported 5 plants within a fenced area in 2003 and none of these were located in 2005. At EO 19 near Bald Mountain, only 30% of the plants in the 2004 search were recorded as reproductive and the site was noted to be very dry with most common species appearing to be stressed. In 2005, standing water was present in the interior of the lakebed but no adult plants were located. It may have been too early to detect adults and it is possible that seedlings were emerging, but went undetected.

Known populations in the Sagehen Springs area were surveyed on August 2-5, 2005. Most of the lake beds contained standing water during the survey period and there were very few adult plants detected at any of the sites. EOs 16 and 17 supported 1 and 10 adults, respectively, but only 3 seedlings were detected at EO 15. Seedlings were not mentioned or described in the updated status report of 2003 and the discovery is apparently the first in recent survey history. EO 16 supported over 2,500 adults in the census in 2003 so it could have produced a large seed bank that year. In 2005, it appeared that the standing water was still inundating previously occupied ground and only seedlings were emerging at the outer edges of the lakebed. The seedlings were very small, averaging less than 3 cm in diameter (see photo CD). They occurred in such large numbers that a transect method was utilized to estimate totals. To place a transect, the lake was visually divided into four equal quartiles and a representative patch was located in each quartile. Seedlings were counted within a 10 by 1m belt transect in each quartile. Total seedling counts in the belt transects were 245, 50, 57, and 125, for an average of 150 seedlings per 10 square meters, or a total of 477 seedlings in 40 square meters. The lake had an approximate diameter of 40 meters with the seedlings occupying a zone around most of the lake that was less than 5 meters wide.

Seedlings may have gone undetected at the other lake beds in the area or had not emerged yet. EO 18 did not support any plants and it is possible that the 8 individuals present in 2003 have been extirpated. Horses occupied the lakebed when surveyors approached and there were very deep hoof prints over the entire bed, large piles of horse dung, and very scattered vegetation that was severely mowed down. Two occurrences have likely been extirpated in the Sagehen springs vicinity. Conditions have not changed at either site since the 2003 survey. The population at EO 23 occurred next to the road in the past, but erosion from the road has caused some channelization and there is no longer an ephemeral lakebed. Similarly, EO 24 at McBride Flat no longer supports suitable POWI habitat, as the lakebed has been filled with *Artemisia spp.* and other shrubs.

Sites in the Anchorite Hills were also searched in early August. EO11 did not support any plants in 2003 or in 2005. The lakebed has been excavated and the hydrology changed to the extent that the entire lakebed now drains into a small catchment (10 x 6 meters) rather than spreading out across the surface. The remainder of the lakebed is dominated by mats of *Polygonum arenastrum* and there is evidence of intense herbivory by rabbits. The lakebed at EO 12 only supported 40 plants, down from the 250-500 estimated in 2003. The dominant species was *Iva axillaris* and rabbit herbivory was also apparent, although not as intense as at EO 11. The new lakebed, EO 28, which was discovered in the 2003 helicopter survey only had 3 adult plants. There is still no indication of use by horses or cattle or OHVs at this remote site.

The large lake in the Pine Nut Range, (EO 22) was surveyed on August 12, 2005. There were 328 plants counted in three large clusters, compared to 250 in 2004. The lakebed was dry at the time of

survey and the clusters of POWI were in the same location as 2004. This was the only site where the number of plants increased from the 2004 count. It may have been that the increased precipitation was still below a threshold where the lakebed did not fill to the point that it inundated previously occupied POWI habitat.

Three of the four Virginia Range sites were visited on August 19, 2005. The number of counted plants was dramatically lower than the 2004 counts at all lakebeds. EOs 1 and 2 supported over 1,000 individuals each in 2004, but less than 500 combined were counted in 2005. The fencing was not intact at either lakebed and surveyors witnessed a dirt bike driving across EO 1.

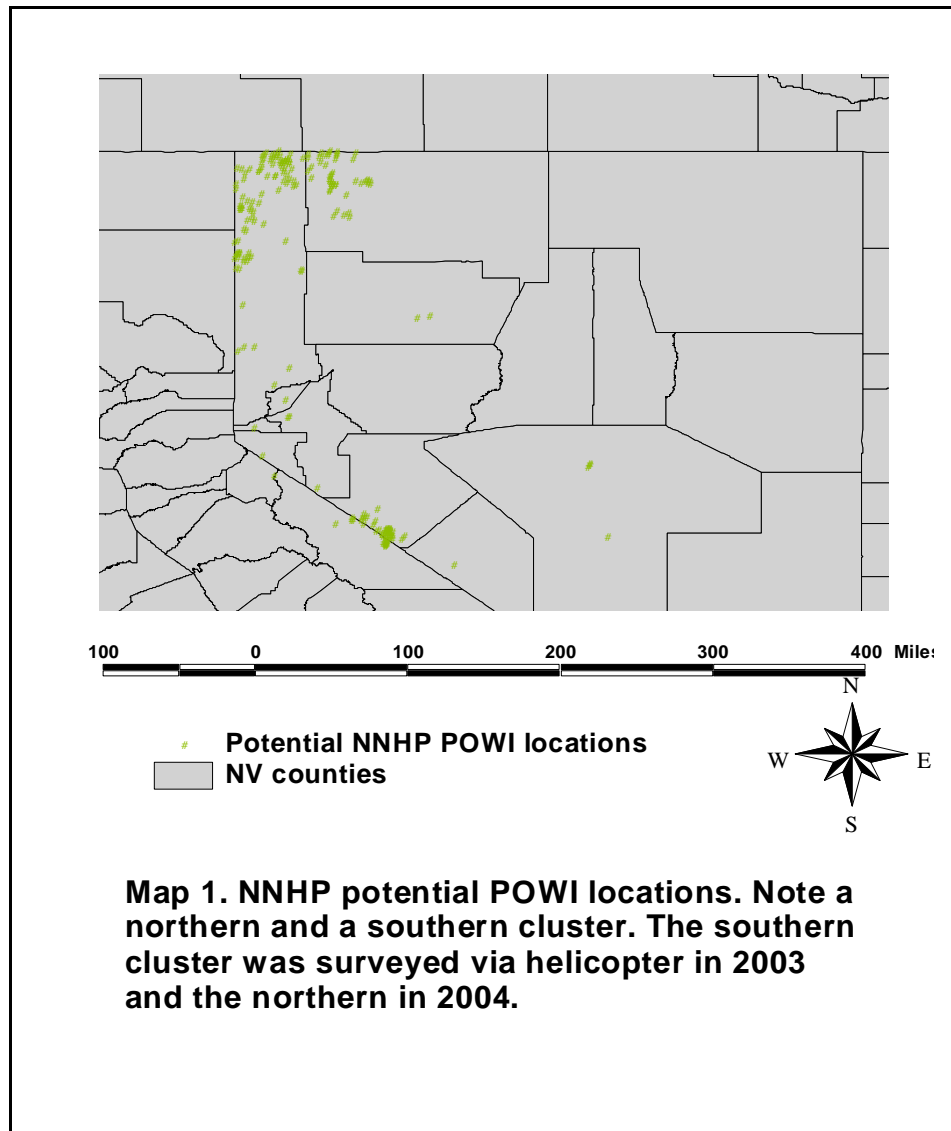
HELICOPTER SURVEYS OF POTENTIAL OCCURRENCES

The 2002 supplement to the 1997 Holland report contained a comprehensive list of potential occurrences of POWI in CA and NV. Jim Morefield scrutinized over 65 topographic quadrangles for POWI habitat features (i.e. dry lake beds) to produce a list of 178 sites of potential occurrence, along with associated maps. The large-scale map of all 178 sites shows two major clusters - one in the very northwestern part of Nevada and the other along the state line between Mineral and Mono Counties (Map 1).

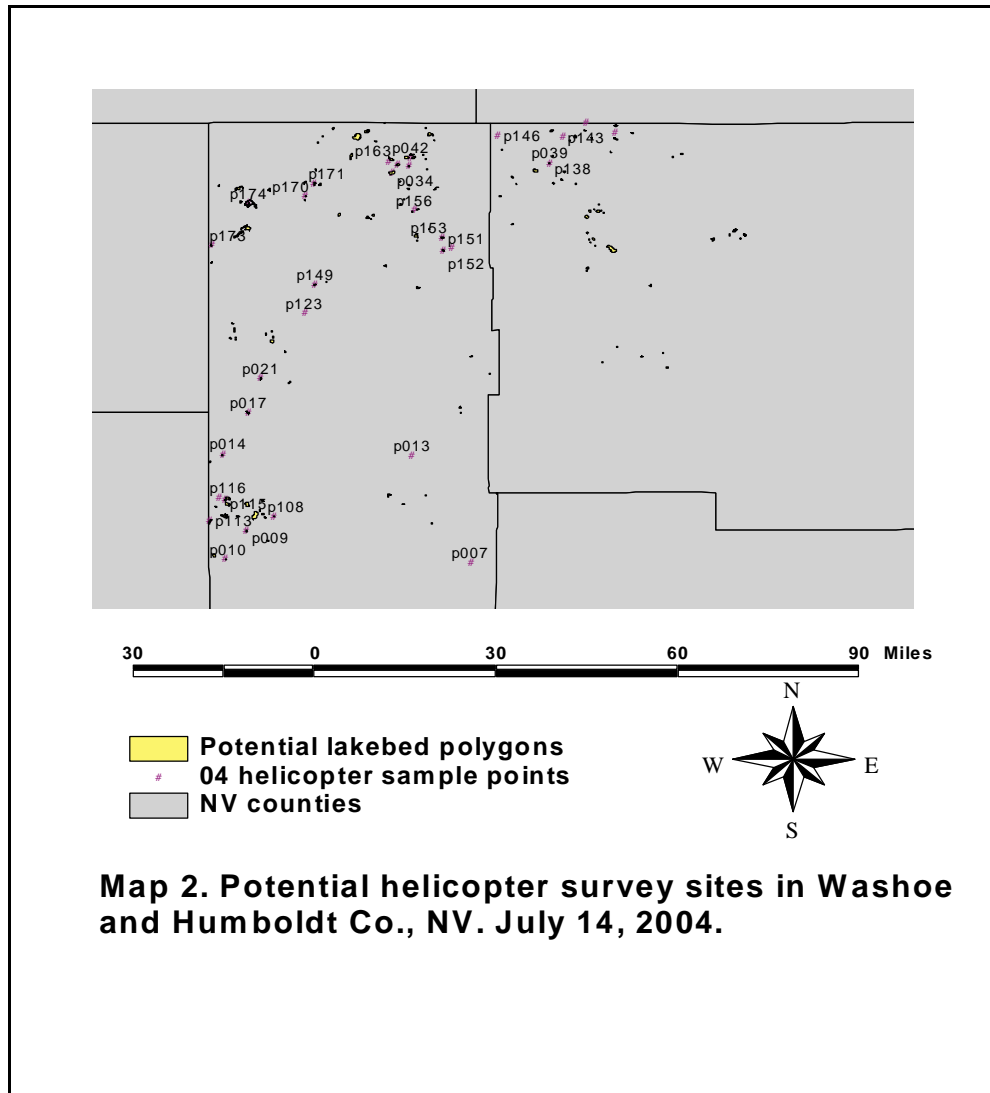
For the first survey in 2003, all potential sites north of Carson City were excluded and a subset of 22 potential sites was randomly selected. Six more sites were eliminated because of time constraints the day of the helicopter survey. On July 16, 2003 BMP Ecosciences visited and/or photographed sixteen potential occurrences along the state line between Mineral and Mono Counties (Table 4). Only one new occurrence in the Anchorite Hills was discovered at P051, very near known EO 11 and 12. That new population may have high conservation potential because the two adjacent existing populations are heavily impacted by water projects (berms, excavation) and cattle, and EO 11 has not supported any plants since 1998.

Table 4. Sites of potential occurrence surveyed by helicopter on July 16, 2003.

Site #	Surveysite	County	Acres	Elevation	# plants
P001	Piper Peak	Esmeralda	1.3	9295	0
P051	Anchorite Pass S	Mineral	1.8	7945	10
P054	Trench Canyon	Mono	23.8	6705	0
P062	Sagehen Spring ENE	Mineral	19.3	7125	0
P063	Huntoon Spring	Mineral	2.8	6790	0
P066		Mineral	3.3	6830	0
P071		Mineral	30.0	6641	0
P073		Mineral	5.0	7420	0
P074		Mineral	7.1	7660	0
P076		Mineral	4.9	7990	0
P082	River Spring	Mineral	13.3	7630	0
P085		Mono	3.5	6870	0
P088		Mono	18.4	7140	0
P090		Mono	34.3	6870	0
P092		Mono	11.3	6520	0
P095		Mineral	12.7	7260	0



From the remaining cluster of 114 potential occurrences in the northwest corner of Nevada in Washoe and Humboldt County, a random subset of 34 sites was selected for a second helicopter survey conducted on July 14, 2004 (Map 2).



A total of 26 potential occurrences and one known *P. fremontii* (POFR) site were visited and/or photographed (Table 5). Some of the potential occurrences included more than one lake bed in close proximity to one another. A total of 43 lake beds were surveyed by helicopter. Some were deemed inappropriate habitat during aerial reconnaissance and not ground surveyed. Generally, these sites were filling in with shrubs, invaded by native perennial or non-native annual grasses, no longer able to support ephemeral catchments of water, submerged or extremely wet (see the explanatory habitat notes in Table 5).

Table 5. Sites of potential occurrence surveyed by helicopter on July 14, 2004. Landings were not made at sites where presence is noted as aerial recon. Ground surveys were conducted at all other sites.

Site #	Potential site name	Acres	Elev	Presence	Habitat notes
P009	Hole In The Ground Spring N	30.0	6240	0	Some companion spp. present, excavated waterhole, berm

Site #	Potential site name	Acres	Elev	Presence	Habitat notes
P010	Little Adobe Flat	22.8	5635	arial recon	very grassy, not suitable
P010	Big Adobe Flat	109.9	5660	arial recon	very grassy, not suitable
P014	Mason Spring north	6.5	5365	arial recon	this is part of Mason spring-standing water, many horses present
P017	The Dry Lake east	3.7	6360	POFR	small dry rocky lakebed, photo #
P017	The Dry Lake	67.0	6140	0	
P021	Mahogany Lake	38.0	7100	arial recon	very grassy, standing water, aspen grove on lake margin, cows
P034	Bald Mountain Lake	232.3	5995	arial recon	filling in with shrubs, very dry
P042	Rye Creek Reservoir SE	92.2	5750	arial recon	filling in with shrubs, very dry
P042	Rye Creek Reservoir SE	77.8	5710	arial recon	2 lakebeds -filling in with shrubs, very dry
P104	Upper Dry Valley	19.0	5390	not located	could not find lakebed
P108	Cedar Canyon NW	8.6	6100	0	thick ,volcanic soil with CATA, IVAX, PSBR
P112	S O B Lake south	0.6	6440	arial recon	very grassy, not suitable
P113	Pilgrim Lake	102.2	6250	arial recon	very grassy, not suitable
P115	Willow Lake north	24.1	6135	0	many antelope, horses cows present
P115	Willow Lake north	135.3	6005	POFR	many antelope, horses cows present
P115	Willow Lake	195.9	6125	0	many antelope, horses cows present

Site #	Potential site name	Acres	Elev	Presence	Habitat notes
P116	Willow Lake NW	12.4	6315	POFR	
P123	Lords Lake NE	3.6	5565	arial recon	adjacent to Highway 34, grassy, excavated wet meadow
P149	The Dip	20.0	5665	0	a dried up well is present, cheatgrass
25?	possible historic site 25		5666	0	dry lakebed w very compacted soil- IVAX, POAR
P151	Bitner Table SE # 1	0.6	5920	0	excavated and very dry
P151	Bitner Table SE # 2		5920	POFR	
P151	Bitner Table SE # 3		5920	POFR	
P151	Bitner Table SE # 4		5920	POFR	
P152	Bitner Table SE	56.2	5965	0	looked suitable
P153	Bitner Table east	56.3	5960	0	looked suitable
P156	Bitner Butte south	8.6	6105	0	2 lake beds
P160	Swan Lake Reservoir NW	30.0	5805	arial recon	late succession- filling in with shrubs
P162	Racetrack Reservoir SE	53.1	5790	arial recon	late succession- filling in with shrubs
P163	Racetrack Reservoir south	4.6	5920	arial recon	late succession- filling in with shrubs
P163	Racetrack Reservoir east	94.4	5735	arial recon	late succession- filling in with shrubs
P170	Horse Lake SSW	11.9	5820	0	altered hydrology, alkali, hard pack clay soil w IVAX, POAR
25?	possible historic site 25		5821	0	altered hydrology, alkali, hard pack clay soil w IVAX, POAR

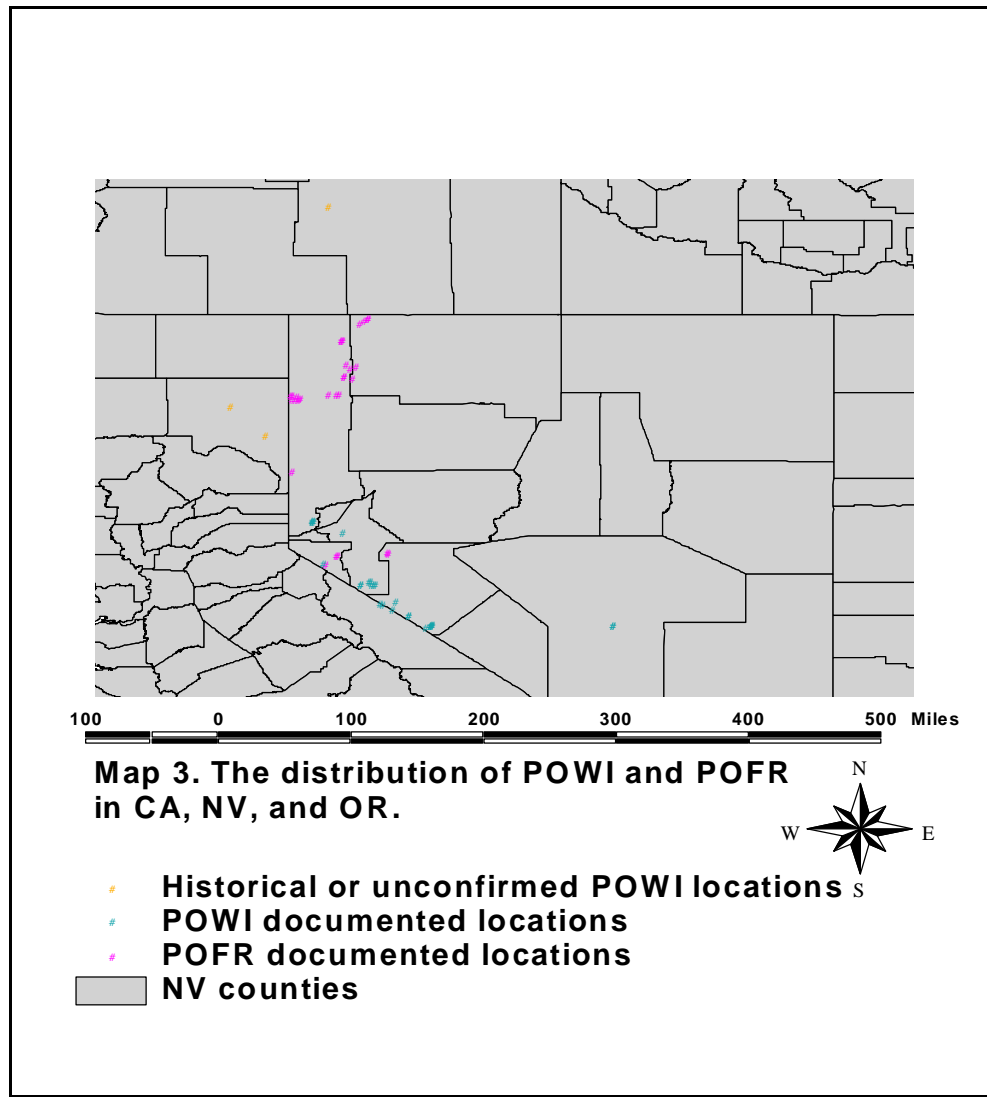
Site #	Potential site name	Acres	Elev	Presence	Habitat notes
P171	Rock Flat	37.8	6060	0	grassy, standing water, cows
P171	Horse Lake	94.6	6215	0	grassy, standing water, cows
P171	Horse Lake west	48.6	5965	0	grassy, standing water, cows
P173	Carter Reservoir SW	34.1	5500	arial recon	filled in with ARTR
P174	Holy Lake east	80.5	6135	arial recon	a spring, grassy and wet, cows
P174	Holy Lake	55.1	6160	arial recon	a marsh
P174	Holy Lake west	48.3	6035	arial recon	standing water
F07	Garden Lake			POFR	

POWI was not detected on any of the 43 lake beds. The only known occurrence of POWI (EO 25) in northwestern NV dates to an herbarium record from 1946 that gives an unclear location. According to Jim Morefield, EO 25 occurred either in the Black Hills of Long Valley in one of two lake beds (potential site 149), or further north in Mosquito Valley on one of two lake beds designated as P170. At P149, the western lakebed at “The Dip” was a dried up well, occupied by an old windmill and invaded by cheatgrass. The eastern lakebed (potential site 25) had extremely compacted soil that supported poverty weed (*Iva axillaris*), knotweed (*Polygonum arenastrum*), and big sagebrush (*Artemisia tridentata*). At P170, both lakebeds had water excavations and cows were present. The soils were hard-pack clay supporting only poverty weed and knotweed. If any of these lakebeds in fact supported POWI in the past, the populations were probably extirpated long ago.

POFR was again found at site F07 in Garden Lake, south of Duck Lake along the California border. It is also known from four other lakes F08-F11 within a four mile radius. POFR was newly discovered within this area on the small middle lake bed at P115 near Willow Lake and the lakebed at P116. About 15 miles north, a population of POFR was discovered at P17 in Dry Lake. Other new POFR populations were discovered in three of the four small lakebeds at P151, about 9 miles east of Massacre Lake. The nearest POFR site previously known from that vicinity occurs 8 miles to the southwest at F24. The discovery of 6 additional occupied lakebeds brings the total number of known POFR locations to 29.

UPDATE OF POLYCTENIUM WILLIAMSIAE DISTRIBUTION

Since the first herbarium specimen of POWI was collected in 1946 and the species was formally described in 1983, there have been a total of 34 documented occurrences in the western US (28 in Nevada, 5 in California, and 1 in Oregon). The closely related species, POFR, has been recently documented at 29 sites, although it is known to be more widely distributed. The updated distributions of both POWI and POFR in CA, NV, and OR are shown in Map 3.



Of the 34 documented POWI occurrences, at least 9 have not been re-documented in the last 10 years (Table 6). For Nevada, no plants were found in the helicopter surveys at four lakebeds that may have historically supported EO 25. Field survey data also indicate that populations at EO 23 and 24 were likely extirpated due to habitat alternations that destroyed the lakebeds or their hydrology. EO 3 and 4 in the Bellehelen Lakes area have not been visited since 1995 when they were full of water and did not support plants. In 2005 surveys of these sites were not planned because of the high precipitation and the likelihood that the lakes were inundated again. EO13 has also not been visited since 1995 because of its remote location. EO 7 has been heavily grazed, but there is anecdotal evidence that plants persisted as late as 2004 (A. Tiehm, pers. communication).

Table 6. Documented occurrences of POWI in Nevada, California, and Oregon (excerpted from Table 1 in Appendix 1, Holland and Morefield (2003).

Site	EOR	Map	Site name/location	Year*	# plants Year *	# Plants 2003/2004	# Plants 2005
1	1	14	Virginia Range; Virginia City	1995	296	1088	190
2	2	14	Virginia Range; Virginia City	1995	1076	1061	280
3	3	2	Bellehelen Lake No 1; Bellehelen	1995	0		
4	4	2	Bellehelen Lake No 2; Bellehelen	1995	0		
5	5	14	Virginia Range; Virginia City	1995	844	1041	
6	6	14	Virginia Range; Virginia City	1995	48	2920	481
7	CA 901	6	Larkin Lake; Cedar Hill	1995	420,000	911	
8	8	10	Nye Canyon North; Wichman Canyon	1999	1129	7	
9	9	10	Nye Canyon South; Wichman Canyon	1999	> 1100	11	
10	7	12	Double Spr. Flat; Double Spr./Carters Stn	1995	0		
11	21	11	Sweetwater Summit SE; Nye Canyon	1999	74	5	0
12	10	7	Mt. Hicks; Mt. Hicks	1994	> 500	131	
13	11	5	Anchorite Hills South; Anchorite Hills	1998	1026	0	0
14	12	5	Anchorite Hills South; Anchorite Hills	1998	> 4300	250	40
15	13	3	Sagehen Spr. NNE; Jacks Spr.	1995	693		
16	14	11	Sweetwater Summit NE; Nye Canyon	1999	273		
17	15	3	Sagehen Spr. WSW; Truman Meadows	1995	153	130	3
18	16	3	Sagehen Spr. West; Truman Meadows	1998	1990	2542	seedlings
19	17	3	Sagehen Spr. NW; Jacks Spr.	1995	136	75	35
20	18	3	Sagehen Spr. North; Jacks Spr.	1995	31	0	0
21	19	9	Bald Mtn. East; Wichman Canyon	1999	> 15000	250	0
22	20	9	Bald Mtn. East; Wichman Canyon	1999	> 1200		
23	23	3	Sagehen Spr. East; Truman Meadows	1998	> 1	0	0
24	24	4	Mcbride Flat; Truman Meadows	1998	> 1	0	0
25	25	15,16	Long Valley; Mosquito Lake/Painted Point	1946	> 1		
26	26	9	Bald Mtn. East; Wichman Canyon	1999	37		
27	22	13	Como NE; Como	1999	> 1	250	328
28	CA 902	17	Mud Flat; Shaffer Mountain	1988	> 1		
29	CA 903	8	Bodie Hills East; Aurora	1983	>1	3	
30	CA 904	8	Bodie Hills West; Aurora/Dome Hill	1996	>1	300	
31	CA 905	18	Madeline Plains; Anderson Mountain	1984	> 1		
32	OR 906	19	Lake On The Trail; Lake On The Trail	1985	> 1		
33	27	13	Como east; Como	2002	> 50	465	
34	28	5	Anchorite Pass south; Anchorite Hills	2003	10		3

In California, only Larkin Lake has been consistently surveyed. BMP searched maps of Lassen County in 2005 for the locations of California sites 902 and 905, documented by herbarium specimens from the 1980's, but could not find reliable locations to warrant a field survey that year.

In Oregon, the history of known POWI occurrences began in 1985 when Barbara Ertter made the first known collection at Lake-on-the-Trail in Harney County, Oregon. Reed Rollins first identified her collection (housed at Oregon State University , collection #173573) as *P. fremontii*, but in

1995, Kenton Chambers (OSU) annotated one plant from the collection as *P. fremontii* var. *confertum*, which was accepted as synonymous with POWI in 2002. Some taxonomic confusion remains, given that the single plants occurred in a distinct population of *P. fremontii*. Despite the confusion, surveyors from the BLM Burns Field Office revisited the Lake-on-the-Trail population in 2002 and apparently discovered 2 new POWI sites southeast of the site by Big Stick Creek and Foster Lake and in the Three Rivers Resource Area, Harney County, Oregon. The taxonomy of the plants from these sites may have not been confirmed and they are not included in the NNHP count of 34 documented occurrences.

POWI is a relatively new species with a small record of occurrences. As of 1983 the species was known from only four lakebeds in the Virginia Range, all within one mile of one another. Holland added greatly to the knowledge of the species distribution with his conservation status report in 1997 and Morefield added critical historical information in the 2003 update. Still, a persistent lack of comprehensive and consistent field data obscures the conservation and management status of the species. Annotation of all specimens by a taxonomic expert contributes to uncertainty with respect to geographic distribution. The surveys contained in this report suggest that POWI occurs at 31 locations instead of 34 because of habitat alterations at 3 previously occupied sites. The locations of 3 historical occurrences could not be confirmed due to imprecise geographic information on herbarium records. Although it is unlikely, these sites could conceivably be occupied. Also, as mentioned above, the species may be more abundant and/or widespread in Oregon.

While it is not possible to know the true global distribution of POWI at this time, the helicopter surveys of potential occurrences in Nevada allow for an informed speculation of the chances of finding more POWI within the state. Morefield's identification of 178 potential occurrences was based on the presence of lakebed features on 65 topographic quadrangles. Some of the potential occurrences included more than one lakebed, so that together, these locations contained 280 lakebeds. Using GIS, he obtained estimates of the total area of each lakebed. Although POWI generally occurs only in a zone of suitable habitat (i.e. confined within a ring near the playa margin) and is not distributed across the entire lakebed, it is likely that the ratio of occupied to unoccupied POWI habitat area is similar among lakebeds despite differences in size. Also, there is no way to estimate potential occupied habitat and, therefore, it is reasonable to present comparisons of total area of potential habitat.

A total of 9,028 acres were identified as potential POWI habitat (Table7). In 2003, a random

Table 7. A summary of potential habitat area and actual surveyed area by year.

	overall	2003	2004
Potential habitat acres identified	9,028		
Potential POWI occurrences	178		
Number of lakebeds with potential habitat area	280		
Potential habitat acres surveyed		192.7	1,916
Potential occurrences surveyed		16	26
Lakebeds surveyed		16	43
POWI acres delineated		1.8	0
POWI lakebeds occupied		1	0

sample of 6% (16) of the total potential number of lakebeds and 2% (192 acres) of the total potential acres were surveyed. This increased sharply in 2004 when 15% (43) of the lakebeds and 21% (1,916 acres) of the total potential area were surveyed. Taken together, 23% of the total identified potential area and 21% of the lakebeds were randomly surveyed by helicopter.

During the 2003 and 2004 surveys, only one new POWI occurrence was found in 2003 at one small lakebed. With an estimated area of 1.8 acres, the new POWI habitat represents 0.08% of the total potential acreage. If the 23% random sample intensity was sufficient (and there is no way to test this) and POWI were to occupy 0.08% of the remaining un-surveyed acreage (6,920 acres), it would be reasonable to expect another 5.8 acres of occupied habitat. Given a calculated median lakebed size of 12.4 acres among the 280 potential lakebeds (with a minimum area of 0.42 acres and a maximum of 505 acres), POWI would be expected at no more than one additional lakebed in Nevada. The calculated median area of 8.6 acres of the 19 occupied POWI sites visited during the 2003 to 2005 surveys yields a similar conclusion and comparisons of mean lakebed area (38 acres for occupied and 32 acres for potential) is of similar magnitude.

POFR was located at an additional 6 lakebeds on 153 acres, or 7% of the total potential area identified as suitable habitat for both species. If POFR were located on 7% of the remaining potential acreage, it would be reasonably expected on 484 acres. Using the median lake area of 12.4, POFR would be expected on 39 lakebeds. If the mean lakebed area of 32 acres is used, the number of expected occupied lakebeds declines to 15.

OCCURRENCE RANKING AND MANAGEMENT

Of the 34 documented occurrences, 10 were not surveyed as part of this project (Table 8).

Table 8. Sites not surveyed or ranked in 2003-2005.

Site	EOR	Site name/location	Last Year surveyed	Notes
3	3	Bellehelen Lake No 1; Bellehelen	1995	Likely inundated in 2005
4	4	Bellehelen Lake No 2; Bellehelen	1995	Likely inundated in 2005
10	7	Double Spr. Flat; Double Spr./Carters Stn	1995	A. Tiehm saw plants in 2004?
15	13	Sagehen Spr. NNE; Jacks Spr.	1995	
16	14	Sweetwater Summit NE; Nye Canyon	1999	
22	20	Bald Mtn. East; Wichman Canyon	1999	
26	26	Bald Mtn. East; Wichman Canyon	1999	Habitat looked good from peak near EO 19
28	CA 902	Mud Flat; Shaffer Mountain	1988	Could not identify a reliable location on a CA map
31	CA 905	Madeline Plains; Anderson Mountain	1984	Could not identify a reliable location on a CA map
32	OR 906	Lake On The Trail; Lake On The Trail	2002	Obtain population info from OR BLM

Occurrences at Bellehelen lakes were scheduled for survey in 2005, but the high precipitation was similar to that of 1995 when Holland found both full of water. The occurrence at Double springs Flat is on private property and access permission was not obtained. However, Arnold Tiehm stated

at the 2005 NV Rare Plant Workshop that he saw plants present on the site through binoculars in 2004. The other four Nevada occurrences, as well as the one in Oregon, were not surveyed because of time and budget constraints. As mentioned above, BMP searched maps of Lassen County in 2005 for California sites 902 and 905, documented by herbarium specimens from the 1980's, but could not find reliable enough locations to warrant a field survey that year.

A total of three historical POWI occurrences have undergone irreversible habitat alterations and would not be expected to support plants in the future (Table 9). The Truman Meadows sites no longer contain open, intact lakebeds due to erosion or shrub encroachment. Using quadrangle maps, Morefield pinpointed the location from the 1946 herbarium specimen as either potential site 149 or p170. Both sites were visited in the 2004 helicopter survey, and neither had suitable POWI habitat.

Table 9. Sites with irreversible habitat alteration, not expected to support plants in the future.

Site	EOR	Site name/location	Last year plants observed	2003-2005 observations
23	23	Sagehen Spr. East; Truman Meadows	1998	Lakebed has become an eroded channel next to road
24	24	Mcbride Flat; Truman Meadows	1998	Shrub encroachment has eliminated lakebed
25	25	Long Valley; Mosquito Lake/Painted Point	1946	Potential sites 149 and 170 in helicopter survey did not support suitable habitat

The remaining 21 occurrences have been prioritized according to relative impacts and accessibility. Current survey data from the Occurrence and Site Forms were combined with historical data to determine habitat quality for each population and to look for relationships between population size, amount of observed disturbance, and site accessibility (i.e. potential for more human disturbance in the future). Surveyors in the field assigned a score of 1 to 4 (lowest to highest observed impact) to document and quantify the effects of non-native grazing animals (horses, cattle and sheep), off-highway vehicles (OHVs, 2- and 4-wheel), general recreation (camping, fire ring building, litter), or hydrological modification (water diversion, excavations, berm or dams). Site accessibility was also scored from 1 to 4 (1 = no vehicle access or remote private property, 4 = easy access from well-traveled roads). These scores were combined for each site and the resulting sum was assigned to one of three categories for ranking the sites. Numerically, the lower the sum, the lower the management effort required to maintain favorable conditions for the POWI population. Low effort rank (sum = 6-8 points), medium effort rank (10-12 pts), and high effort rank (13-16) are shown in Table 10.

Table 10. Ranking of POWI occurrences based on human impacts and accessibility. The lower the sum and rank, the lower the management effort to maintain favorable habitat conditions for the species.

EOR	Location Name	Impact Ranking				Impact Score	Access Score	Sum	Rank	# Plants
		Grazers	OHV	Rec	Hydro					
1	Virginia Range	3	4	3	1	11	4	15	H	1,088
2	Virginia Range	3	3	2	1	9	4	13	H	1,061
5	Virginia Range	2	4	2	1	9	4	13	H	1,041
6	Virginia Range	2	4	4	1	11	4	15	H	2,920
CA										
903	Bodie Hills East	4	4	2	1	11	3	14	H	3
21	Sweetwater SE	4	4	4	1	13	4	17	H	0
11	Anchorite Hills	3	2	2	4	11	3	14	H	0
10	Mt Hicks	3	1	1	1	6	1	7	L	131
	Sagehen Spring									
15	WSW	2	1	1	1	5	2	7	L	130
	Sagehen Spring									
16	W	2	2	1	1	6	2	8	L	2,542
	Sagehen Spring									
17	NW	2	1	1	1	5	2	7	L	75
	Sagehen Spring									
18	N	3	1	1	1	6	2	8	L	0
19	Bald Mtn East	2	1	1	1	5	1	6	L	250
28	Anchorite	2	1	1	1	5	1	6	L	50
12	Anchorite Hills	2	2	2	3	9	3	12	M	250
CA										
901	Larkin Lake	3	2	2	2	9	3	12	M	911
CA										
904	Bodie Hills West	4	2	2	1	9	2	11	M	300
22	Como NE	3	3	2	1	9	1	10	M	250
	Como east-									
27	(Private)	3	3	2	1	9	1	10	M	465
9	Nye Cyn South	3	2	2	1	8	3	11	M	11
8	Nye Cyn North	2	2	2	1	7	3	10	M	7

A total of 7 sites were ranked “High” management effort, indicating that these sites have been highly impacted and have an ongoing potential for more impact. As such, they would require drastic changes in current management, and possibly restoration, in order to maintain their POWI populations. The 7 sites ranked as “Moderate” have intermediate levels of impact and accessibility, while the 7 sites ranked as “Low” show few signs of human disturbance and are either remote or difficult to access. Such broad categories allow for discussion of general management issues in relation to the status of the species. Discriminating between impact and accessibility is useful for identifying site-specific management options. The general issues will be addressed first and then more site- or region-specific options will be presented.

General Management and Status

The first pattern that emerges from the occurrence ranking is obvious: more accessible sites have greater human impacts. However, this relationship does not provide any insight into factors that control POWI population sizes. Four of the most easily accessed and most impacted occurrences (in the Virginia Range) still support large numbers of plants. However, two occurrences that were also ranked “High” did not support any plants and one had only 3 individuals. . Discriminating between impact and accessibility is useful for identifying effective, site-specific management options

To evaluate the intensity of each type of impact, the impact scores were summed for all occurrences. Grazers (including horses, cattle, and sheep), with a score of 54, were having the greatest impact on POWI habitat quality. Specifically, the impact was primarily from trampling and wallowing that churns up the surface of the lakebed, rather than herbivory. OHV impacts were a close second with a score of 48. Sites that had the highest OHV use tended to have slightly lower impacts from grazers. This may be due to the fact that vehicles tend to scare animals away. Vehicles tracks were observed off of adjacent roads, on the lakebed habitat, and directly over POWI individuals. Recreation on these remote lakebeds is closely linked to OHV access, but impacts other than vehicle use (evidenced by campsites, fire rings, gun shells, and litter) were observed and scored. The combined recreation score was 39. Finally, there were few examples of intentionally-altered hydrology, only three sites received a score other than a one, for combined total of 26. Observed examples included basin deepening and berm building.

Precipitation is a critical factor affecting POWI population performance that lies outside the realm of management. Annual precipitation was below normal at most sites during 2003 and 2004, and most of the region had experienced several consecutive years of extended drought. In these years, the lakebeds dried early in the season, exposing more habitat for POWI and grazers abandoned the sites presumably to search for other water sources. Consequently, population sizes were high in 2003 and 2004 (see Table 6). However, precipitation increased in 2005 to above-normal level, filling lakebeds with water, reducing the amount of suitable POWI habitat, and allowing grazers to return. Consequently, populations were low and plants were absent at many formerly occupied lakebeds. Therefore, it appears that successive, wet years (or enhanced accumulation of water in the basins) would be a greater threat to the species than extended drought. Increased hydroperiod in occupied basins might trigger special management to maintain their POWI populations.

The presence of invasive, non-native plants (i.e. weeds) was evaluated separately from the other impacts as a component of habitat quality. Weeds were observed at nearly half of the POWI occurrences (45%), during the survey period. In 2003-2004, most of the infestations were not identified as aggressive and contributed less than 15% cover within POWI habitat. *Erodium cicutarium* (filaree) was prevalent at two of the Virginia Range sites, covering about 20% at EO 6. *Bromus tectorum* (cheatgrass) was present at all of the Virginia Range occurrences in low amounts, except for EO 6, where it had about 20% cover. *Lepidium latifolium* (tall whitetop) was present at EO 1. At occurrences that were re-visited during 2005, the canopy cover of all vegetation was generally higher, including the weed component. For example, at EO 2 in the Virginia Range, total cover by all plant species ranged from 60% in 2003 to >75% in 2005. *Lepidium perfoliatum* appeared on this lakebed and at EO 6. During years of high precipitation,

cover from non-natives not only increases, but the chances for weed seed dispersal are increased with prolonged use by wild horses and other grazers.

Table 11. Location and identity of non-native weeds detected at all surveyed sites.

EO	Location Name	Non-native species present
10	Mt Hicks	0
		0
15	Sagehen Spring WSW	0
16	Sagehen Spring W	0
17	Sagehen Spring NW	0
19	Bald Mtn East	0
28	Anchorite	0
1	Virginia Range	<i>Bromus tectorum, Lepidium latifolium</i>
2	Virginia Range	<i>Bromus tectorum, Erodium cicutarium, Malva parviflora,</i> <i>Polygonum arenastrum, Lepidium perfoliata</i>
5	Virginia Range	<i>Bromus tectorum, Polygonum arenastrum</i>
6	Virginia Range	<i>Bromus tectorum, Erodium cicutarium, Lepidium perfoliata,</i> <i>Descurania sophia</i>
12	Anchorite Hills	0
		0
CA 903	Bodie Hills East	
21	Sweetwater SE	<i>Bromus tectorum, Erodium cicutarium, Descurania sophia</i>
11	Anchorite Hills	<i>Polygonum arenastrum</i> <i>Chenopodium album</i>
CA 901	Larkin Lake	
		0
CA 904	Bodie Hills West	
22	Como NE	<i>Bromus tectorum, Lepidium perfoliatum</i> <i>Bromus tectorum, Lepidium perfoliatum</i>
27	Como east- (Private)	
9	Nye Cyn South	0
8	Nye Cyn North	0

Site-specific Management Recommendations

The site-specific management recommendations were categorized according to two factors: 1) the Conservation Value of the occurrence and 2) the Management Priority. Conservation Value was assigned as Low, Moderate, or High and Management Priority could be Low, Moderate, High, or No Action. A total of 6 occurrences have High Conservation Value and Management Priority, 6 occurrences have Moderate Conservation Value and Management Priority, 4 occurrences of Moderate Conservation Value require No Action, 2 occurrences have Low Conservation Value and Management Priority, and 3 occurrences of Low Conservation Value require No Action (Table 12).

Table 12. The assigned Conservation Value and Management Priority of 21 POWI occurrences.

EO	Location Name	Conservation Value	Management Priority
1	Virginia Range	High	High
2	Virginia Range	High	High
5	Virginia Range	High	High
6	Virginia Range	High	High
CA 901	Larkin Lake	High	High
CA 904	Bodie Hills West	High	High
15	Sagehen Spring WSW	Moderate	Moderate
16	Sagehen Spring W	Moderate	Moderate
17	Sagehen Spring NW	Moderate	Moderate
18	Sagehen Spring N	Moderate	Moderate
12	Anchorite Hills	Moderate	Moderate
22	Como NE	Moderate	Moderate
10	Mt Hicks	Moderate	No Action
19	Bald Mtn East	Moderate	No Action
28	Anchorite	Moderate	No Action
27	Como east- (Private)	Moderate	No Action
9	Nye Cyn South	Low	Low
8	Nye Cyn North	Low	Low
CA 903	Bodie Hills East	Low	No action
21	Sweetwater SE	Low	No action
11	Anchorite Hills	Low	No action

The conservation value was assigned based on a combined assessment of both the management effort ranking and the population size. Some occurrences with large numbers of plants warrant a High Conservation Value despite a high management effort ranking. Although the impacts at these sites are complex and it may take more effort to protect and conserve these populations, the limited number of other POWI occurrences and overall low total population place a higher burden of protection on high population sites. Conversely, the conservation value of those occurrences that ranked high in management effort but have supported few or no plants during the survey period is much lower. The effort required to restore such occurrences is too great and the overall benefit to the species would be low so these were designated as Low Conservation Value No Action sites. Occurrences that require lower management effort and support moderate to high population size were categorized as having both Moderate Conservation Value and Management Priority. Occurrences with Moderate Conservation Value that are very remote would require No Action. Finally, occurrences with low population size and a moderate management effort ranking fell into the category of Low Conservation Value and Management Priority.

High Value Occurrences in Nevada for Conservation and Management: Virginia Range (EOR 1,2,5,6)

Occurrences in the Virginia Range are primarily impacted by OHV use because of easy accessibility. The BLM has installed fencing and signage in an effort to prevent driving on occupied lakebeds, but subsequent vandalism has been intense: the signs have been shot and removed and the fences cut down. All attempts to repair this damage have been met with continued vandalism. The cover and diversity of weeds appear to be increasing, as OHVs aid in seed dispersal between and within lakebeds. Nevertheless, these occurrences still supported 53% of the known POWI plants in 2003 and at least 43% (not including EO 5) during 2005. Therefore, these occurrences appear to still have high conservation value and warrant additional management effort to prevent further degradation of the habitat.

A more effective management approach might be to develop OHV open areas in the Virginia Range that concentrate use away from POWI occurrences. This would require the cooperation of OHV user groups to design routes and desirable features and find ways of promoting responsible recreation. Perhaps the area near EO 1 could be designated as a point of recreational access in order to divert riders and drivers before they reached the occupied lakebed. New features and even new roads could lead to a defacto decommissioning of routes that go through POWI habitat. It may also be possible to replace fencing in some areas with logs, rocks or dense shrub “hedges” to deter access in sensitive or ambiguous points along the new route.

High Value Occurrences in California for Conservation and Management: Larkin Lake (CA 901) and Bodie Hills West (CA 904)

The POWI occurrences at Larkin Lake and Bodie Hills W were ranked as sites requiring moderate levels of management effort. The sites supported a combined total of 1,211 plants in 2003, the entire known POWI population in California. Holland estimated that Larkin Lake supported the majority of all known POWI in 1995 with an estimated count of 420,000, but this may have been an overestimate if all suitable lakebed habitat was assumed to be occupied. The primary impact to plants at Larkin Lake is from trampling by wild horses. Although there has been an active horse removal program in the area, it has been controversial and its efficacy unknown. Continued use of the site by horses will continue to degrade POWI habitat. In addition if the adjacent private property to the south is developed, access and OHV use will likely increase. Protection of this site is complex and will likely require participation from multiple stakeholder groups.

The Bodie Hills West occurrence is not on the main road to Bodie State Park, so it has had fewer impacts than the occurrence to the east. Both have been heavily used by cattle in the past but less so in recent years. The West site supported 300 plants and could support more in the future if cattle remain at low levels and horse impacts are minimized. OHV use is minimal since the site is less visible from the road. The Bodie Hills East site should be a no action site so that management is focused on the West site (see below).

Moderate Value Occurrences for Conservation and Management

Occurrences that had low impacts and low accessibility fall into two categories: 1) moderate management priority (those with relatively large populations of more than 50 plants in any one survey year that are worth expending management effort), or 2) no action (those that consistently support small populations of less than 50 plants or are on private property). The two occurrences in the Pine Nut Range have intermediate levels of impact, are very remote and support large populations, so they are included in these categories.

Category 1 (Moderate Management Priority): Sagehen Spring EO 15,16,17,18 Como NE EO 22 Anchorite Hill EO 12

The Sagehen Springs occurrences are relatively remote and have low levels of human impacts. In dry years they support moderate to large numbers of individuals and in the wet year (2005) there was a massive recruitment event at one of the sites. The livestock allotments for these sites were closed to accommodate wild horse use (1988 Horse Management Plan CRMP) and now the primary impact is trampling from the horses.

Fencing has not been tried in the area and it may prove effective because of the remoteness. Although it may be out of compliance with the Horse Management Plan, trial permits should be sought to fence two of the four lakebeds. Plants were not detected at EO 18 during the recent survey period and the site had higher impact from horses. Fencing this site to exclude horses could potentially allow for a re-colonization event to occur. In addition it would be desirable to fence EO 17 in order to observe the response of the existing POWI population. This site is not accessible by road so the fence would focus on the effects of excluding horses rather than effects of OHV users. Both types of fence would provide much needed information on the impact of wild horses on POWI.

The Como NE occurrence (EO 22) was the only site that had a greater number of plants in 2005 than in 2004. The reasons for this remain unclear. However, the site supports a relatively large population and should be a moderate conservation priority. A primary threat to POWI habitat quality at this site comes from weeds. Hand-pulling could reduce weed competition and increase available habitat. Targeted herbicide application should only be undertaken with a replicated experimental design so that any benefits or impacts to POWI plants are clearly assessed.

The Anchorite Hills occurrence (EO 12) is in a complex playa system of many small lakebeds and connecting stream courses, separated by constructed berms, roads, and islands of mature sagebrush. It was difficult to discern the impacts of the berm construction and altered hydrology on the population. Management efforts should focus on limiting grazing activity. This site would present an excellent research opportunity to investigate the effects of different hydrological restoration activities. It is large and any successful rebound in population could benefit the two nearby occurrences.

Category 2 (No Action):
Bald Mtn East (EO 19), Anchorite Hills (EO 28), Mt Hicks (EO 10), Como (EO 27)

Two of these occurrences (EO 19 and 28) are not accessible by road and two (EO 10, 27) are on private property. Implementing any management activities at these sites would be difficult or unlikely. They have a moderate conservation value because they support plants that persist with little human disturbance, but they should not or cannot be the focus of management efforts.

Low Value Occurrences for Conservation and Management

Category 1 (Low Management Priority):
Nye Canyon (EO 8, 9)

These two occurrences had scores that reflected moderate impacts and accessibility. Although very few plants were present during 2004, they have supported large populations (over 1,000 each) in the past. Both sites are part of the Bald Mountain Sheep Allotment and permit restrictions include a stipulation to avoid grazing on lakebeds that support POWI. Compliance with these restrictions should be monitored and the populations should be surveyed in both moderate and high precipitation years to document trends.

Category 2 (No Action):
Anchorite Hills (EO 11), Sweetwater Southeast (EO 22), Bodie Hills East (CA 903)

These occurrences ranked high in impacts and accessibility but have supported few or no plants during the survey period. The hydrological impacts at EO 11 may be irreversible, as the plant community is now dominated by common knotweed. Observed rabbit herbivory was very high at this site and it is not known what impact this might have on any restoration efforts. Intense herbivory would make it difficult to re-establish certain species that are palatable to rabbits. Management efforts in the vicinity would be better directed toward EO 12.

Similarly, the Bodie Hills East occurrence has been very impacted by cattle and the effects of altered hydrology in the basin may not be reversible. Efforts in that vicinity would be better directed toward the Bodie Hills West site.

The Sweetwater Southeast occurrence is subjected to intense recreation and OHV use. The enclosure has effectively excluded grazers, but it may have been erected too late to benefit the POWI population. Only 5 plants were observed in 2002 and none were located in 2004. The plant community is apparently in the process of transitioning to a Wyoming sage community that would not be likely to support POWI.

SUMMARY

To satisfy the requirement of grants NV-E-5-TP-1 and 2, this project addresses three objectives: 1) update the current knowledge of POWI conservation status with results from field surveys of

known occurrences conducted in 2003-2005, 2) categorize sites by degree of impact and accessibility and rank sites according to conservation and management priority, and 3) update the known distribution of POWI with results from helicopter surveys of potential occurrences conducted in 2003-2004.

According to the most recent update on the conservation status of POWI, there have been a total of 34 documented occurrences in the western US (28 in Nevada, 5 in California, and 1 in Oregon) (Morefield 2003). Of the 34 documented occurrences, 7 recently known occurrences in Nevada were not surveyed as part of this project and the locations of 3 historical occurrences in California could not be confirmed due to imprecise geographic information on herbarium records. Field surveys found that 3 historical POWI occurrences in Nevada have undergone irreversible habitat alterations and would not be expected to support plants in the future. If all other sites are presumed extant, POWI occurs at a maximum of 31 locations (25 in Nevada, 5 in California, and 1 in Oregon). In Nevada, an additional three occurrences did not support any plants during the survey period (and may not in the future), but the results of the helicopter surveys suggest that POWI could be found at one additional lakebed (see below). In California, POWI currently occupies only two sites so efforts to identify the two historical locations and potential habitat are certainly warranted. In Oregon, recent data indicate that the species may be more abundant and/or widespread, but taxonomic confusion remains.

The discovery of additional large, remote, populations of POWI would lessen the conservation burden on highly impacted sites. However, the helicopter surveys determined that there is a very small chance that there are still such undiscovered populations. Nearly 60 lakebeds in Nevada were surveyed and POWI was discovered at only one location. Given this low detection rate, the summary analysis indicated that POWI could be present at one small additional lakebed in the state at most. While the possibility of additional population discoveries may remain for California and Oregon, the conservation status of POWI in Nevada is likely to decline in the absence of active management.

The 21 occurrences that were surveyed were prioritized according to relative impacts and accessibility. The first pattern that emerged from the occurrence ranking is obvious: more accessible sites have greater human impacts. Grazers (including horses, cattle, and sheep) were ranked as having the greatest impact on POWI habitat quality through the trampling and wallowing that churns up the surface of the lakebed. OHV impacts were a close second. Weeds were observed at nearly half of the POWI occurrences during the survey period, but most of the infestations were not identified as aggressive. However, years of high precipitation could increase cover from non-natives and the chances for weed seed dispersal with prolonged use by wild horses and other grazers. Site impacts were observed over a range of climatic conditions from drought to above normal precipitation and it appeared that wet years (or enhanced accumulation of water in the basins) would be a greater threat to the species than extended drought. Increased hydroperiod in occupied basins might trigger special management to maintain their POWI populations.

The ranking of impact and accessibility was used to identify site-specific management options and develop recommendations. The site-specific management recommendations were categorized according to the conservation value of the occurrence and the management priority. The conservation value was assigned based on a combined assessment of both the management effort

ranking and the population size. Larger populations were considered to have higher conservation value even if the required management effort was high. Likewise, occurrences that supported few to no plants that required high management efforts were considered to have low conservation value and not require management action. The resulting management recommendations balance the need for protection with different levels of management.

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